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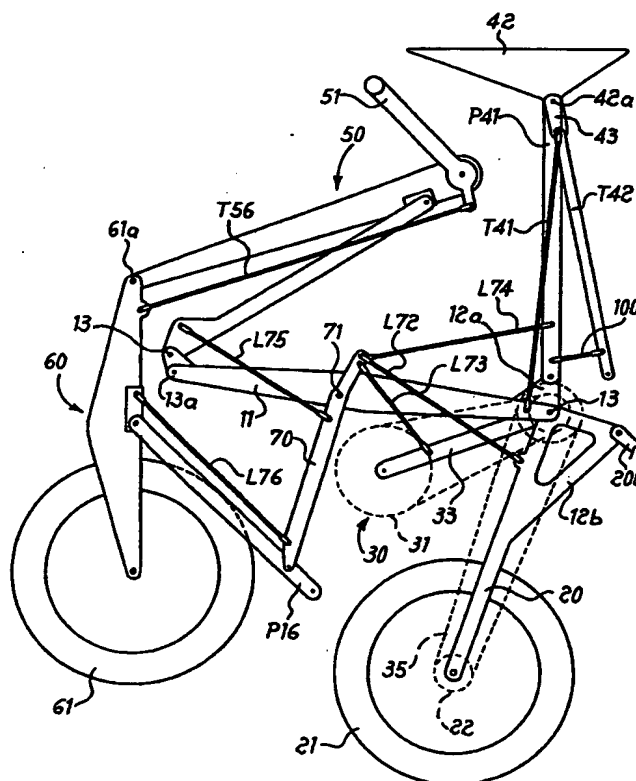
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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**MI98A000191**      **2 February 1998 (02.02.98)**      **IT**(71)(72) Applicant and Inventor: **BELLI, Alessandro [IT/TT]; Via Volta, 17, I-20121 Milano (IT).**(74) Agent: **RAIMONDI, Alfredo; Piazzale Cadorna, 15, I-20123 Milano (IT).**(81) Designated States: **AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).****Published***With international search report.**Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.*(54) Title: **TWO-WHEELED VEHICLE WITH FRAME WHICH CAN BE FOLDED UP BY ACTUATION CONTROL AND TRANSMISSION MEANS**

## (57) Abstract

Foldable two-wheeled vehicle comprising a frame in which there is provided at least one central body (10), at least one group (20) supporting the rear wheel (21), at least one group (60) supporting the front wheel (61) and at least one group (50) for steering the front wheel (61), which are respectively hingeably joined to the said central body (10), there being provided means for controlling (70) and actuating (L72, L73, L74, L75, L76) the rotation of said groups (20, 50, 60) around the said central body (10), so as to close/open the frame from an open configuration suitable for use to a closed configuration suitable for transportation and vice versa.



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Two-wheeled vehicle with frame which can be folded up  
by actuation control and transmission means

Description

5 The present invention relates to a two-wheeled vehicle provided with a frame which can be folded up by means of associated means for control of the actuation and transmission.

10 It is known that in the production of frames for two-wheeled vehicles, in particular bicycles, the established technology consists in the manufacture of a frame of the traditional type formed by tubes which are made of various materials and welded together.

15 These frames, although they have managed to achieve a very high ratio in terms of their own weight against the carrying weight, are such, however, that neither their weight nor their overall dimensions can be further reduced to a significant degree.

20 It is also known that there has always been a need to obtain a folding frame which is such that the overall dimensions can be reduced so as to allow easier transportation by the user both over one's shoulder and on-board other vehicles.

25 There have been numerous designs of bicycles where folding has been based on the division of the frame into two sections, essentially a front section and a rear section, which can be rotated about a central hinging axis parallel to a longitudinal plane of symmetry of the bicycle which is essentially vertical and passes through the two wheels when they are aligned with one another.

30 A frame for two-wheeled vehicles is also known from IT-1,248,931 in the name of the same Proprietor, said frame consisting of a reticular structure forming  
35 functional sections such as the steering, the pedal

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group, the saddle group and the forks for the wheels.  
The technical problem which is posed, therefore, is  
that of providing a frame for two-wheeled vehicles such  
as bicycles, mopeds and the like, which is low-weight,  
5 functionally equivalent to a normal frame and can be  
folded up into its smallest size and opened out into  
its normal size in an automatic and repeatable manner  
without the need for co-ordination of the operations by  
the user.

10 Within the scope of this problem, a further requirement  
is that the frame should be easy and inexpensive to  
produce industrially and to assemble.

These technical problems are solved according to the  
present invention by a foldable two-wheeled vehicle  
15 comprising a frame in which there is provided at least  
one central body, at least one group supporting the  
rear wheel, at least one group supporting the front  
wheel and at least one group for steering the front  
wheel, which are respectively hingeably joined to the  
20 said central body which comprises means for controlling  
and actuating the rotation of said groups around said  
central body, so as to close/open the frame from an  
open configuration suitable for use to a closed  
configuration suitable for transportation and vice  
25 versa.

Further details may be obtained from the following  
description of a non-limiting example of embodiment of  
the invention provided with reference to the  
accompanying drawings, in which:

- 30 - Figure 1 shows a perspective view of a bicycle with a  
frame according to the invention in the condition where  
it is totally open, ready for normal use;  
- Figure 2 shows a cross-section along a longitudinal  
plane of symmetry of the bicycle illustrated in Fig. 1;  
35 - Figure 3 shows a cross-sectional view of the bicycle

according to the invention, similar to that of Fig. 2, with the frame half-folded; and

- Figure 4 shows a cross-sectional view, similar to that of Fig. 2, with the frame fully folded.

- 5 As illustrated in Figure 1, the frame for two-wheeled vehicles according to the invention is composed of a central body 10 formed by two parallel bars 11, the respective opposite ends of which are connected together in the transverse direction by pins 13.
- 10 Said pins 13 have also pivotably mounted on them corresponding gussets 12a and 12b, i.e. front gussets and rear gussets, respectively, which are arranged on opposite sides and on the outside of the said bars 11.
- 15 A pair of struts P15 for connecting the section 10 to a steering bar 50 are also connected to the front gussets 12a.
- A further pair of struts P16 connects a group 60 forming the fork of the front wheel 61 to a lever 70 which is pivotably mounted between the bars 11 as described in detail further below. The end of said
- 20 struts P16 opposite to the end fastened to the front fork is designed to engage into a corresponding seat 13a of the pin 13 so as to cause locking thereof.
- The handlebar 51 is joined to one end 50a of the steering bar 50 by means of associated transverse pins,
- 25 while the other end 50b of the steering bar is joined, by means of a pin 61, to the fork 60 of the wheel 61.
- The opposite ends of a tie-rod T56 are respectively pivotably mounted on the steering bar 50 and the fork
- 30 60, so as to connect the two parts.
- The fork 20 of the rear wheel 21 is pivotably mounted on the rear pin 13.
- Two struts P41 are also pivotably mounted on said gussets 12b, the saddle 42 being mounted on the top end
- 35 of said struts by means of a pin 42a.

- The same pin 42a of the saddle also has pivotably mounted on it one end of a connecting rod 43, the other end of which is joined to a connecting-rod pin 43a, with which a tie-rod T41 connecting the saddle group to the bar 11 of the group 10 and a tie-rod T42 connecting the saddle group to the rear fork are also hinged; the strut P41 and the tie-rod T42 are connected together by a lever 100 for co-ordinating the relative movement.
- The rear fork 20 and the front fork 60 have, arranged between them, pairs of tie-rods T23 and T63 for supporting the pedal group 30 comprising a gear 31 from which the pedals 32 extend and which is rotatable by means of a bracket 33 about the rear pin 13, said gear 31 being connected to the pinion 22 of the rear wheel by means of a transmission 34 and a belt 35.
- The load-bearing structure of the bicycle is completed by further tie-rods T14 and T15 arranged between the central section 10 and the saddle group 40 and the steering group 50, respectively.
- As illustrated in greater detail in the cross-section of Fig. 2, the said lever 70 is arranged inside the central group 10 and rotates about a fixed pin 71 arranged transversely with respect to the two bars 11. Further pairs of rods are pivotably mounted on the opposite ends 70a and 70b of the lever 70, i.e.:
- L76 connecting the end 70a to the fork 60 of the front wheel 61;
  - L75 connecting the lever 70 to the strut P15 of the steering group 50;
  - L73 connecting the end 70b of the lever 70 to the bracket 30 of the pedal group 30;
  - L72 connecting the end 70b of the lever 70 to the rear fork 20;
  - L74 connecting the end 70b of the lever 70 to the struts P41 of the group 40 supporting the saddle 42.



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Said rods, as will emerge more clearly below, allow automatic folding of the frame into a totally closed configuration illustrated in Fig. 4 to be obtained.

In the totally open position ready for use, the bicycle  
5 is kept locked by means of a lever 200 designed to cause reaction of the strut P16 against the seat 13a of the front pin 13 which ensures locking of all the component parts of the bicycle.

More in detail and with reference to Fig. 3, the frame  
10 is operated in the following manner:

- starting from a totally open position illustrated in Fig. 1, the handle 200 is rotated so as to release the tie-rods T41 from the rear fork 20 and eliminate the locking force on the struts P16 which are now free to  
15 disengage from the pin 13 of the central group 10; and
- the control lever 70 is operated, causing it to rotate in an anti-clockwise direction about the pin 71;
- during its rotation, the lever 70 causes rotation also of all the rods L72, L73, L74, L76 which, reacting  
20 against the respective parts connected to them, cause closing of the frame into the configuration shown in Fig. 4.

The pedals may be folded equally well at the start or at the end of the closing sequence so as to eliminate  
25 the associated transverse volume which is occupied.

It must be emphasized that all the moving parts rotate substantially simultaneously, but at different speeds so as to cause automatically the correct sequence of displacements which allow closing of the frame without  
30 relative interference.

All the rotations of the individual moving parts occur moreover in planes which are substantially parallel to the longitudinal plane of symmetry of the frame and about pins substantially perpendicular to said plane.

35 It is therefore obvious how the combination consisting

of the frame and the means for rotational actuation of the individual parts allows easy, automatic and repeatable closure of the vehicle according to the invention without the need for complicated operations

5 by the user.

In addition to this, it is also envisaged that said control means 70 for opening/closing thereof may be servo-assisted by corresponding means of the elastic or electromechanical type.

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CLAIMS

1. Foldable two-wheeled vehicle comprising a frame in which there is provided at least one central body (10), at least one group (20) supporting the rear wheel (21), at least one group (60) supporting the front wheel (61) and at least one group (50) for steering the front wheel (61), which are respectively hingeably joined to the said central body (10), characterized in that it comprises means for controlling (70) and actuating (L72,L73,L74,L75,L76) the rotation of said groups (20,50,60) around the said central body (10), so as to close/open the frame from an open configuration suitable for use to a closed configuration suitable for transportation and vice versa.
2. Vehicle according to Claim 1, characterized in that the pins on which said groups (20,30,60) of the frame are pivotably mounted are arranged in a direction substantially perpendicular with respect to a longitudinal plane of symmetry of the vehicle.
3. Vehicle according to Claim 1, characterized in that said central body (10) comprises pins (13) arranged transversely.
4. Vehicle according to Claim 1, characterized in that said means for controlling closing/opening of the frame consist of a lever (70) hingeably mounted on a fixed pin (71) integral with said central body (10).
5. Vehicle according to Claim 3, characterized in that at least one pair of said pins (13) has an external seat (13a) designed to engage with a corresponding end of a pair of struts (P16) arranged between the group (60) supporting the front wheel (61) and the said control lever (70).
6. Vehicle according to Claim 1, characterized in that said means for actuating the rotational movements of the various groups consist of transmission rods

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(L76,L72,L73,L74,L75), at least one end of which is pivotably mounted on said control lever (70).

7. Vehicle according to Claim 6, characterized in that said lever (70) has hingeably mounted on it the first ends of two transmission rods (L76,L75), the other ends of which are respectively hingeably joined to the group (60) supporting the front wheel (61) and to the steering group (50).

8. Vehicle according to Claim 6, characterized in that the lever (70) has pivotably mounted on it a first end of a transmission rod (L72), the other end of which is pivotably joined to the group (20) supporting the rear wheel (21).

9. Vehicle according to Claim 3, characterized in that a pair of struts (P15) arranged between the central section (10) and the steering group (50) is rotationally connected to said front pins (13).

10. Vehicle according to Claim 1, characterized in that the steering group (50) and the group (60) supporting the front wheel (61) are pivotably joined together and connected by a tie-rod (T56) for coordinating the relative movement.

11. Vehicle according to Claim 1, characterized in that it also comprises a group (40) supporting a saddle (42) and a group actuating one of the two wheels (21,61).

12. Vehicle according to Claim 11, characterized in that said group supporting the saddle (42) consists of a pair of struts (P41), one end of which is pivotably joined to the saddle (42) by means of a pin (42a) and the other end of which is pivotably mounted on the central body (10).

13. Vehicle according to Claim 11, characterized in that said pin (42a) of the saddle (42) has pivotably mounted on it the first end of a connecting rod (43),

the other end of which is connected to a tie-rod (T42) arranged between the group (40) and the fork (60).

14. Vehicle according to Claim 11, characterized in that the end of said tie-rod (T42) connected to the  
5 fork group (60) can be released therefrom by means of a release lever (200).

15. Vehicle according to Claim 11, characterized in that tie-rods (T14) are arranged between said group (40) and the central body (10).

10 16. Vehicle according to Claim 11, characterized in that said lever (70) has pivotably mounted on it a first end of a transmission rod (L74), the other end of which is pivotably joined to the strut (P41) of the group (40) supporting the saddle (42).

15 17. Vehicle according to Claim 11, characterized in that said group (30) actuating one of the two wheels is pivotably mounted on the transverse pin (13) of the central body (10).

18. Vehicle according to Claim 11, characterized in  
20 that tie-rods (T36,T32) are arranged between said group (30) and the two groups (60,20) supporting the two - front and rear - wheels, respectively.

19. Vehicle according to Claim 11, characterized in that said control lever (70) has pivotably joined to it  
25 the first ends of transmission rods (L72,L73), the other ends of which are respectively pivotably joined to the group (20) supporting the wheel (20) and to the group supporting the actuating means (30).

20. Vehicle according to Claim 11, characterized in  
30 that said means for actuating the vehicle consist of a pedal group (30).

21. Vehicle according to Claim 11, characterized in that said means for actuating the vehicle consist of a motor.

35 22. Vehicle according to Claim 1, characterized in

that it is a scooter.

23. Vehicle according to Claim 1 and 20, characterized in that it is a bicycle.

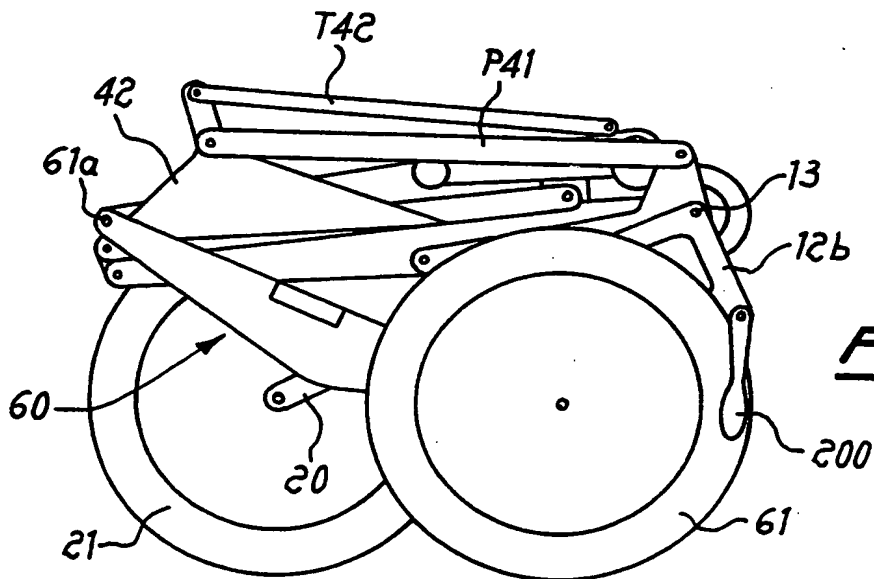
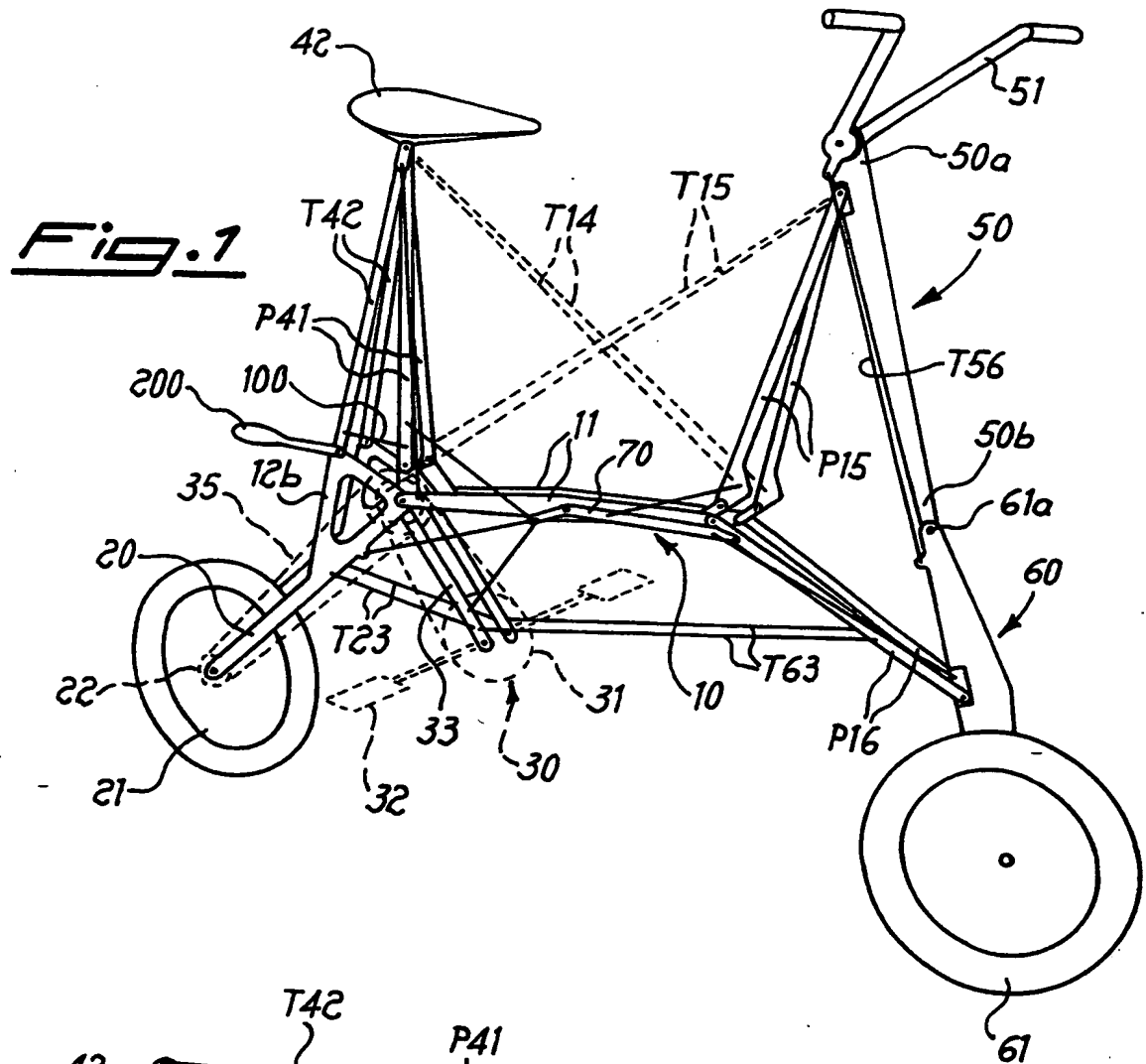
5 24. Vehicle according to Claims 1 and 21, characterized in that it is a motorcycle.

25. Vehicle according to Claims 1, characterized in that said means (70) for controlling opening/closing thereof are servo-assisted.

10 26. Vehicle according to Claim 25, characterized in that said servo-assisting means are of the elastic type.

27. Vehicle according to Claim 25, characterized in that said servo-assisting means are of the electromechanical type.

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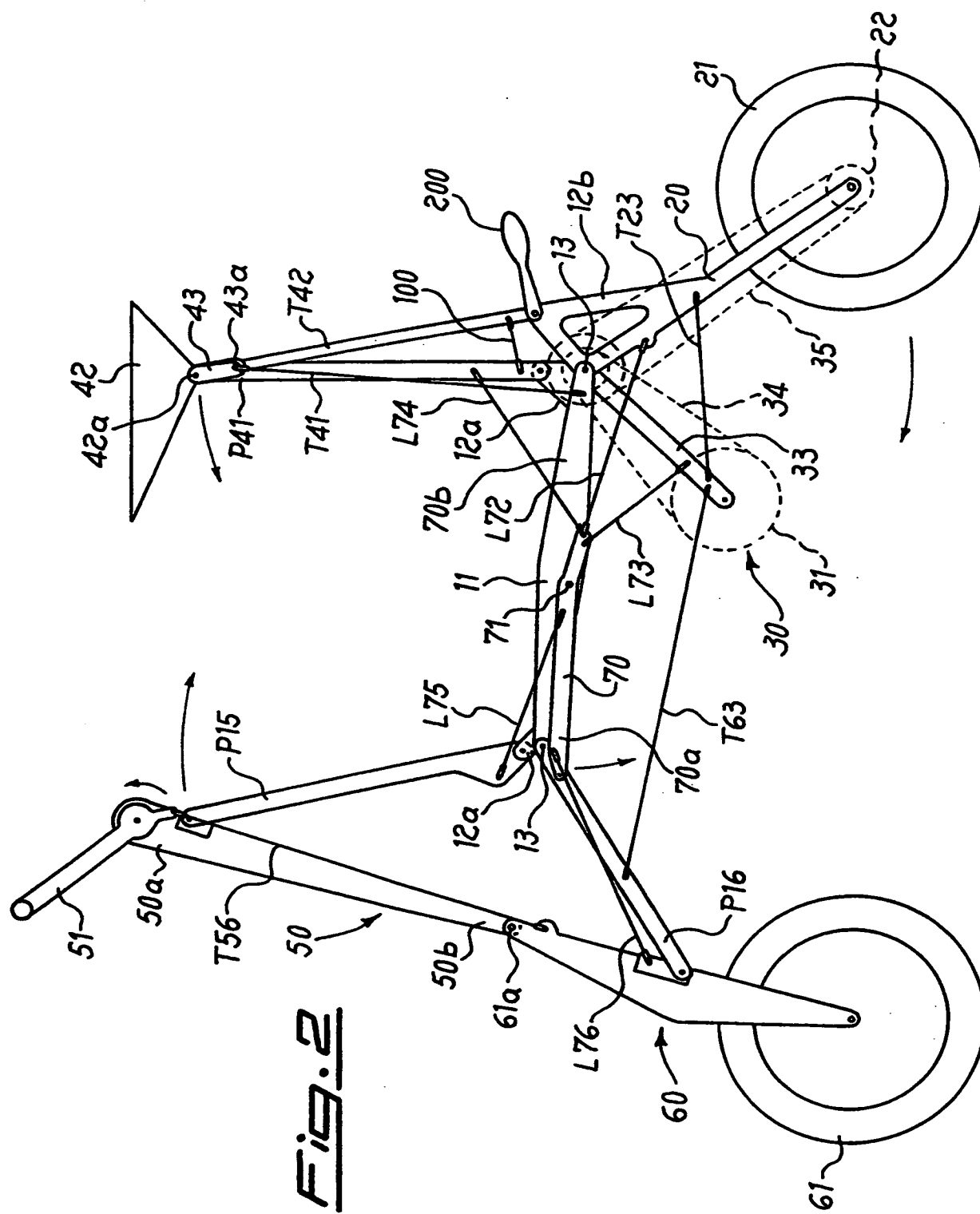
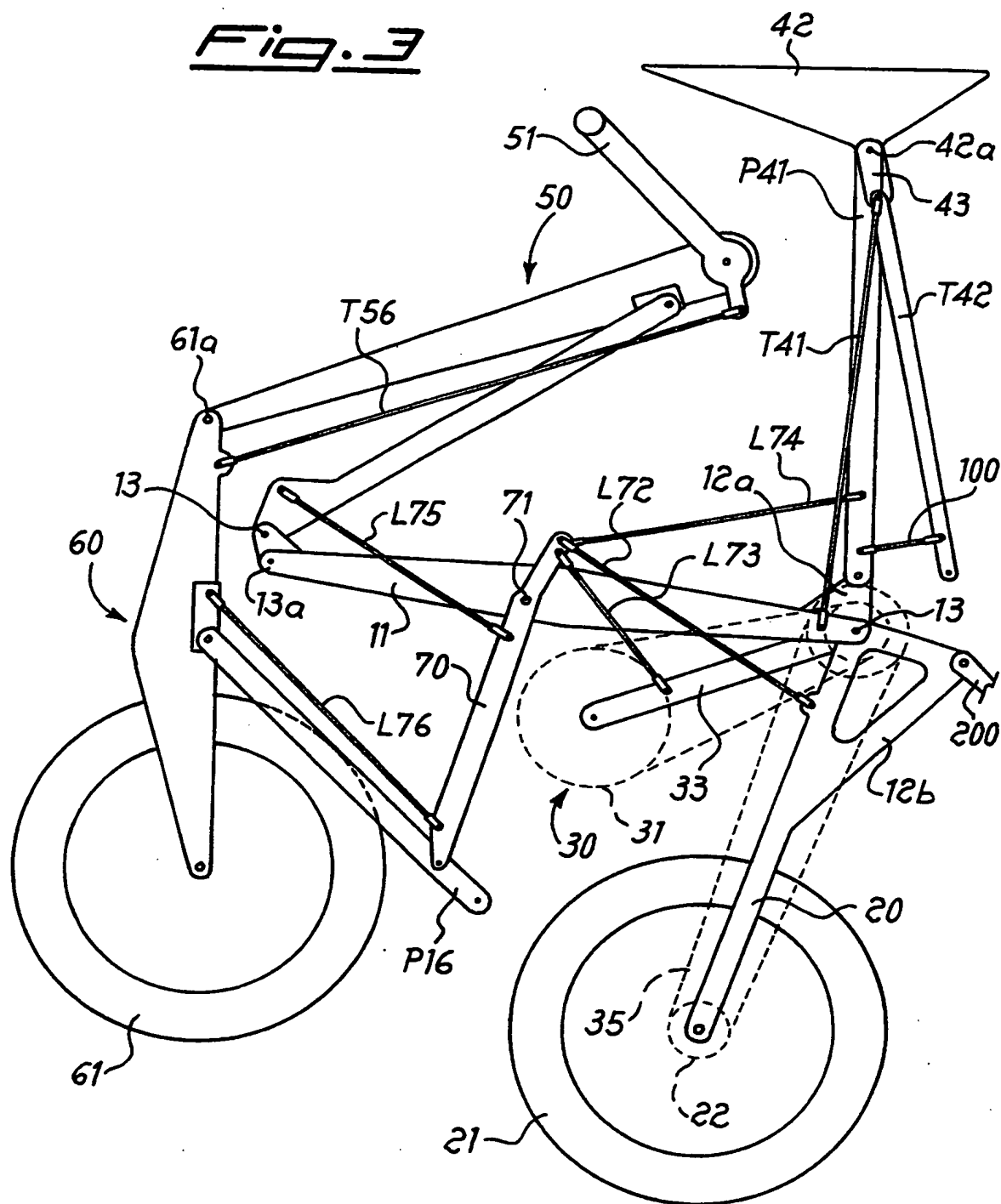


Fig. 2



Fig. 3



# INTERNATIONAL SEARCH REPORT

Inter. onal Application No.

PCT/EP 99/00500

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 6 B62K15/00

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 6 B62K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 990 717 A (BEST) 9 November 1976	1-4,6-8, 10,11, 15,16,20 12,21-24
Y	see column 6, line 66 - column 7, line 68; figures	5,9,13, 14, 17-19, 25-27
A		
X	GB 2 021 055 A (HERBERT) 28 November 1979	1-3
A	see claims; figures	4-6,9
Y	US 4 824 131 A (THAY) 25 April 1989 see column 2, line 5 - line 27; claims; figures	12
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	US 4 844 494 A (BLANCHARD) 4 July 1989 see column 6, line 30 - line 34; claims; figures -----	21-24 1,11,12

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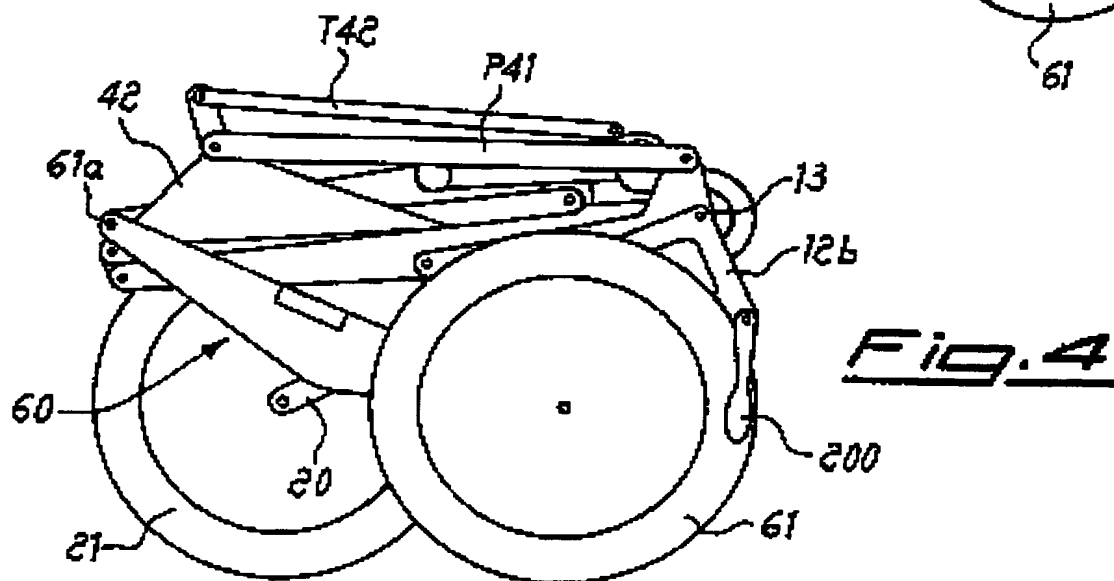
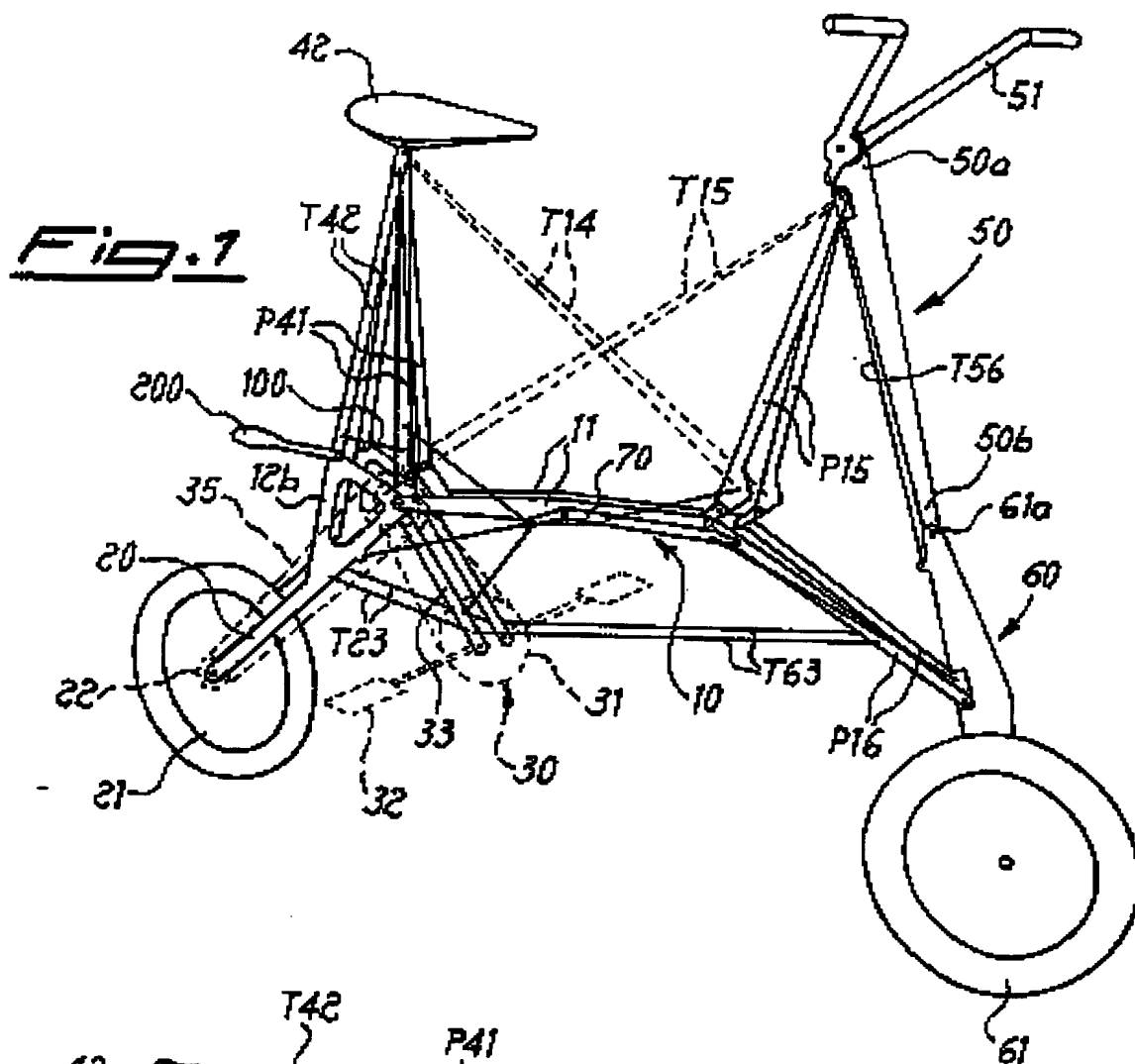
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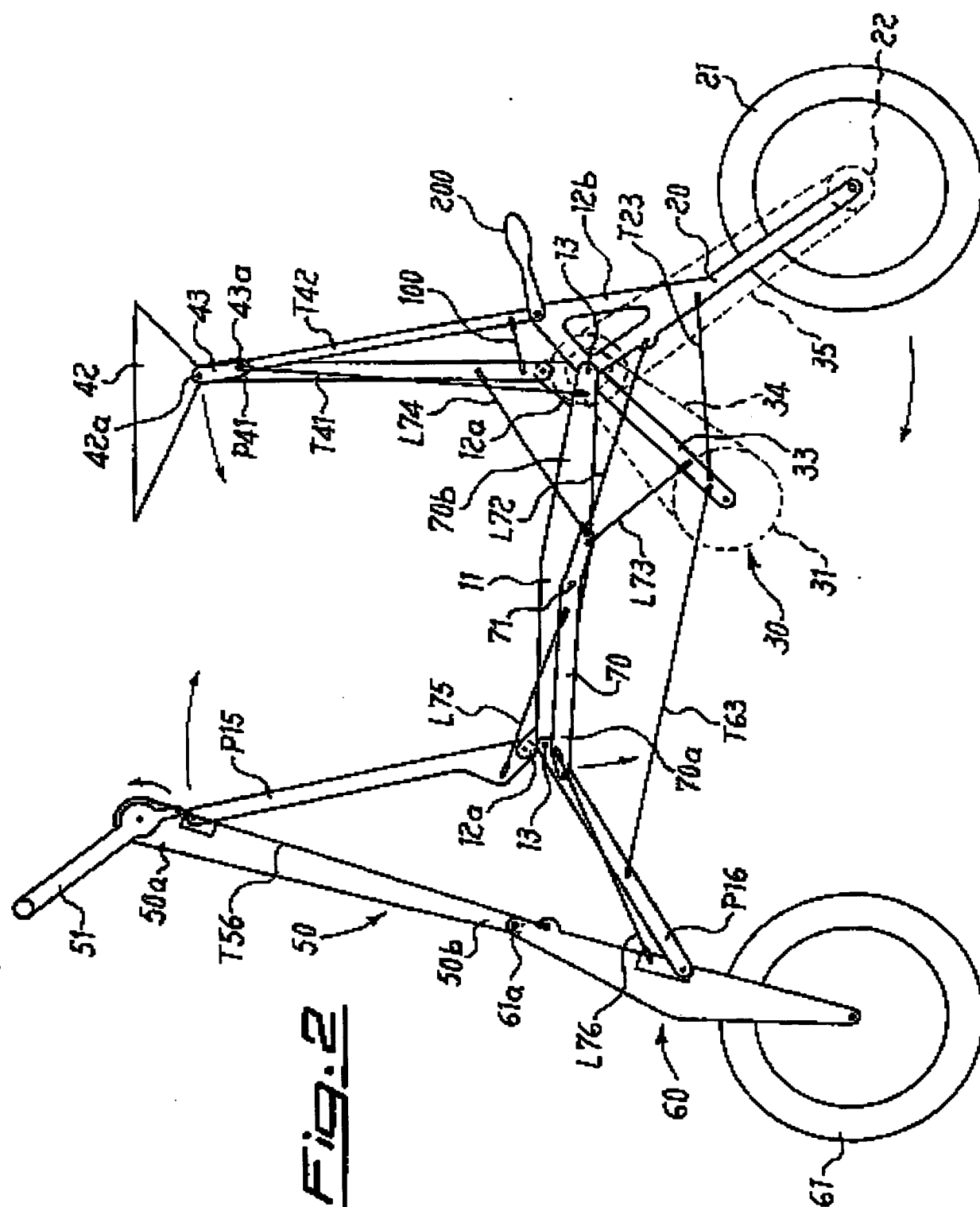
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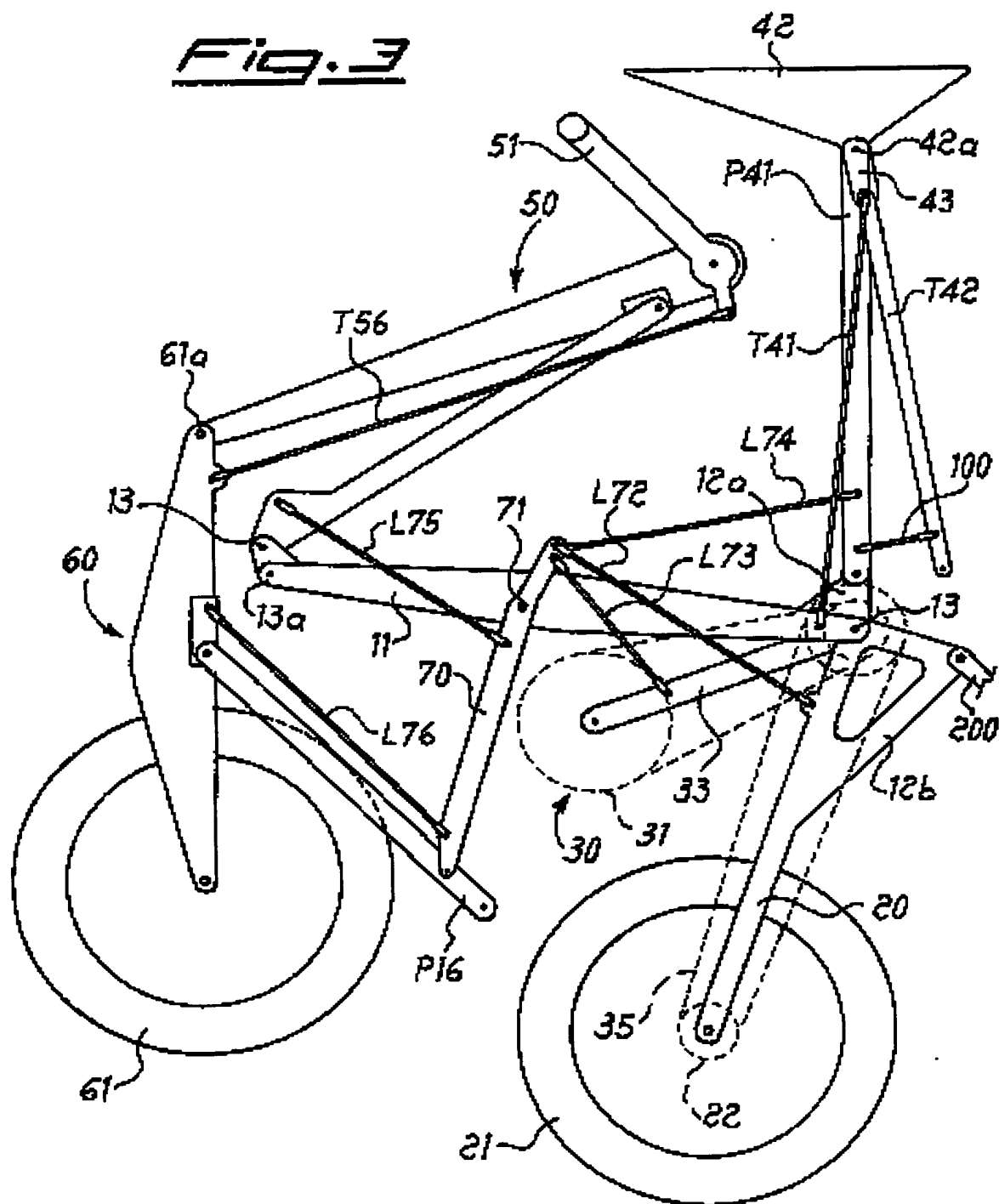
Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3990717 A	09-11-1976	NONE	
GB 2021055 A	28-11-1979	AU 525745 B	25-11-1982
		AU 4723879 A	29-11-1979
		DE 2919674 A	29-11-1979
		FR 2426606 A	21-12-1979
		JP 54155541 A	07-12-1979
		US 4296940 A	27-10-1981
		ZA 7902425 A	30-07-1980
US 4824131 A	25-04-1989	GB 2214880 A	13-09-1989
US 4844494 A	04-07-1989	NONE	

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**Fig. 2**

Fig. 3

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